DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

FULLERVILLE AMETHYST DEPOSIT
SEC. 51W, HD BOOLEROO, CO. FROME
(P.M. 69 - R.G. COLLINS)

Rept.Bk.No. 79/40

GEOLOGICAL SURVEY

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DM No. 1180/72
GS No. 6158

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ABSTRACT

Amethystine and clear crystalline quartz infills fractures and cavities in quartzite of the Belair Sub Group of Proterozoic Age, near Fullerville in the mid north of South Australia.

The quartz crystals range in colour from milky to clear through light and dark purple to nearly black. Crystal form is poor due to intergrowth within the veins and mild deformation during crystal growth.

Most of the amethystine quartz is of specimen value with only minor amounts of semi-precious material being available.

INTRODUCTION

A small deposit of amethyst, the semi-precious purple variety of quartz is located near Fullerville in the mid-north of South Australia. The deposit was inspected by J.G. Olliver (Supervising Geologist) and the authors on 3rd June 1978.

Four samples were submitted to the Australian Mineral Development Laboratories (Amdel) for petrographic examination. The results are discussed herein and the full descriptions comprise the Appendix.

LOCATION AND ACCESS

The Fullerville Amethyst Deposit, on section 51W, hundred of Booleroo, County Frome is located 8 km west of Booleroo Centre and 5.5 km northeast of Murray Town (Fig. 1) in the southern Flinders Ranges. The deposit is in the Mid North Planning Area, within the boundaries of the District Council of Port Germein.

Access from Murray Town is northward for 4.5 km along the main sealed road to Melrose, thence eastward along an unsealed road for 2.3 km towards Fullerville (Fig. 2). From here a track through private property leads northwards for about 600 m along the eastern boundary of section 51W.

The deposit is situated on the crest of a low range of scrub covered hills. The terrain within section 51W is gently undulating and the northern half of the section has been partially cleared for cropping and grazing. The amethyst deposit is on the boundary between the cleared land and the natural mallee scrub (Fig. 3).

MINERAL TENURE AND PRODUCTION

Private Mine 69, of 5.3 ha was granted to R.G. Collins on 15th March 1973.

The only recorded production was 22.7 kg in 1974.

GEOLOGICAL SETTING

The accompanying geological plan (Fig. 2) is based on the ORROROO geological map (Binks et al 1968). The amethyst deposit is situated within the Belair Sub-Group, a sequence of siltstone, quartzite and minor dolomite of Adelaidean age. These rocks are underlain to the east by greenish-grey laminated siltstone, Saddleworth Formation equivalent, whilst to the west the overlying Appila Tillite is largely obscured by alluvium.

At the deposit the rocks strike northerly to north easterly and dip moderately to steeply westwards. Soils and colluvium restrict outcrop to the more resistant, less weathered quartzite.

FIGURES 3-6 ARE MISSING

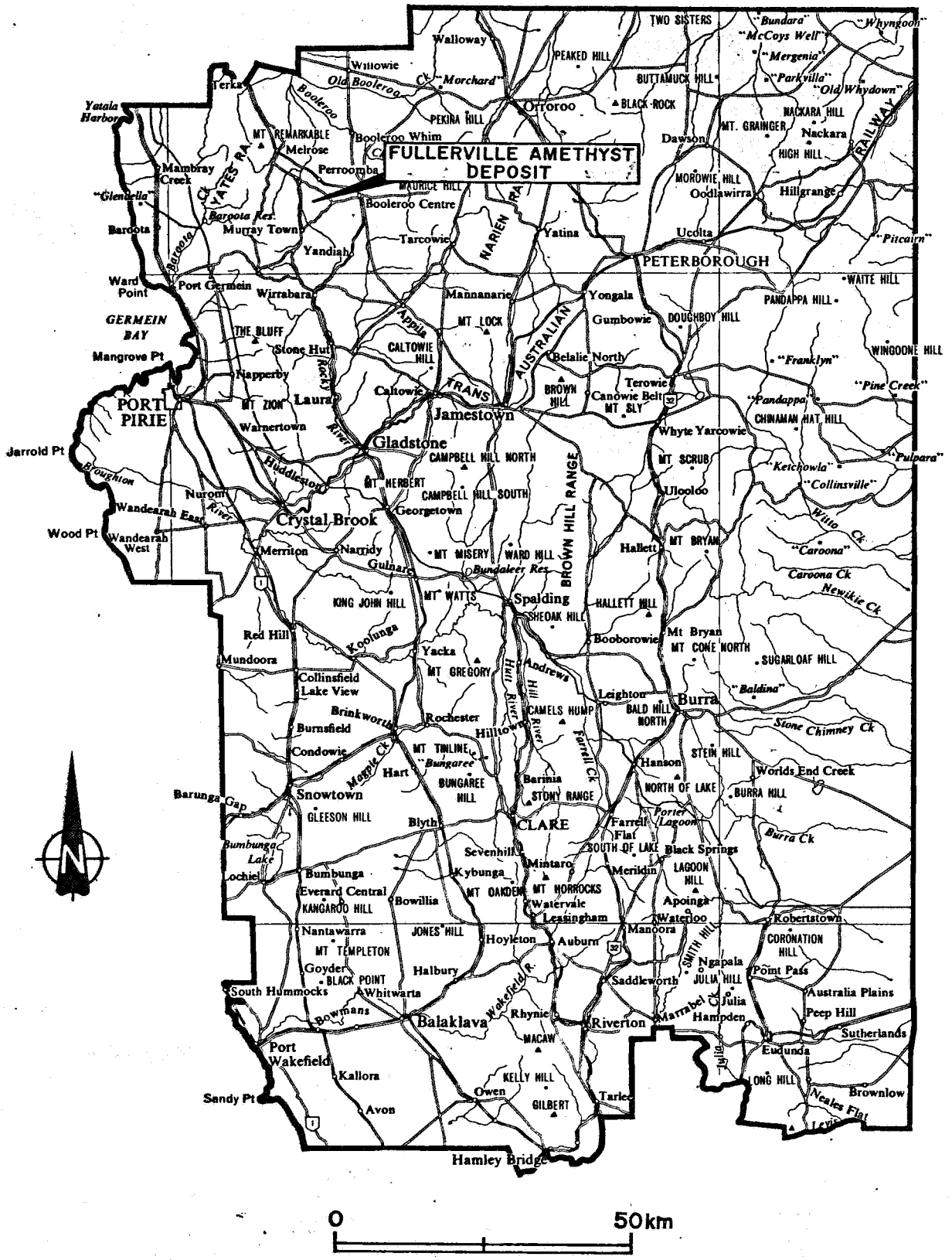

Fig.1

	DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	SCALE: 1:1000 000
COMPILED: P.P.C.	MID NORTH PLANNING AREA	DATE: 14 · 11 · 78
DRN: A.F. / CKD:	FULLERVILLE AMETHYST DEPOSIT LOCALITY PLAN	PLAN NUMBER S13784

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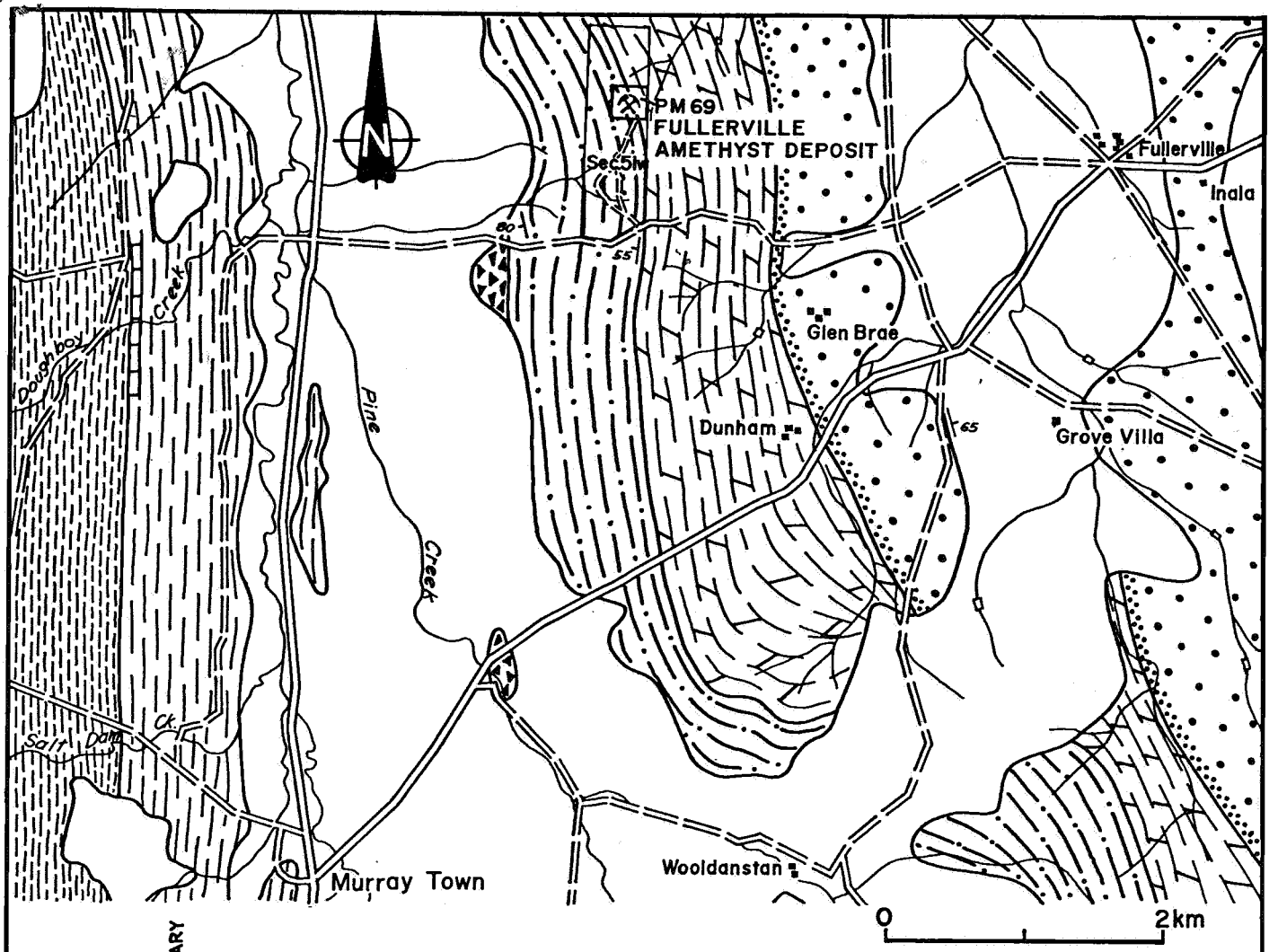

QUATERNARY

Alluvium and slope deposits.

ADELAIDEAN

WILLOCHRA FORMATION: (Un-named Member) Flaggy red-brown siltstone. Thin interbeds of sandstone and sandy limestone.

TAPLEY HILL FORMATION: Flaggy well laminated blue-grey siltstone.

APPILA TILLITE: Massive boulder tillite, siltstone and sandstone.

Belair Sub-Group
Grey siltstone and quartzites.

Grey, green-grey laminated siltstone and dolomite.

MINBURRA QUARTZITE: Pale-grey to brown fine to medium grained, cross bedded quartzite.

CRADOCK QUARTZITE: Pale-grey, medium to coarse grained feldspathic quartzite.

Strike and dip of bedding 55

Geological boundary . . . . . .

Main road, road . . . . . .

Farm buildings . . . . . .

Creek . . . . . .

Fig. 2

	DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	SCALE: 1:50000
COMPILED: P. P. C.	FULLERVILLE AMETHYST DEPOSIT	DATE: 14 · 11 · 78
DRN: A.F. CKD:	PM 69 SEC. 5lw HD. BOOLEROO	PLAN NUMBER
	GEOLOGICAL PLAN	S13785

Fig. 3 - Fullerville Amethyst Deposit. (June 1978)

View southeastwards across pit. Cleared land with rubbly quartzite subcrop in foreground - natural scrub in background.

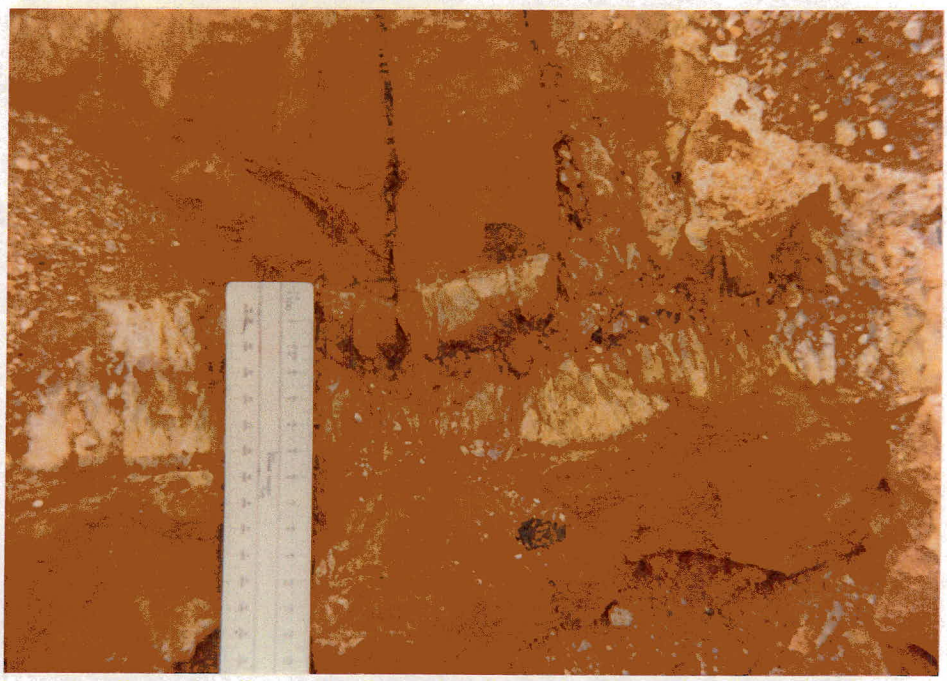

Fig. 4 - Fullerville Amethyst Deposit. (June 1978)

Quartz vein in slightly weathered quartzite showing milky quartz margins and amethystine centre.

Fig. 5 - Fullerville Amethyst Deposit
Quartz vein in quartzite showing well formed clear quartz crystalls in centre of vein. (Scale in millimetres).

Fig. 6 - Fullerville Amethyst Deposit
Typical Quartz vein material showing poorly formed interpenetrating crystals. Colour varies from milky to clear to purple to almost black.

Fig. 3 - Fullerville Amethyst Deposit. (June 1978)

View southeastwards across pit. Cleared land with rubbly quartzite subcrop in foreground - natural scrub in background.

Fig. 4 - Fullerville Amethyst Deposit. (June 1978)

Quartz vein in slightly weathered quartzite showing milky quartz margins and amethystine centre.

THE AMETHYST DEPOSIT

Site Geology

The amethyst deposit has been opened up by a broad bulldozer excavation about 3 m deep at its deepest point (Fig. 3).

Within the trench, deeply weathered quartzite is exposed in the centre, whilst less weathered brownish weathering quartzite is exposed along the northern face (Fig. 4). The quartzite is cut by veins of crystalline quartz. In the centre of the pit, several veins coalesce to form a patch of quartz several metres across.

Outside the trench, the only outcrop is some rubbly slightly weathered orange brown quartzite to the north.

The quartzite (P 810/78 and P 811/77) is composed largely of detrital quartz grains set in an argillaceous matrix. Minor detrital feldspar, zircon and tourmaline are scattered through the rock whilst several percent of opaque iron oxides are concentrated into poorly defined bands. The rocks have been very slightly metamorphosed, probably during folding, with some recrystallisation of the quartz and conversion of the original clayey matrix material to finely felted sericite.

The amethystine quartz crystals are confined to the veins, vughs and patches of crystalline quartz within the quartzite. The crystalline quartz infills a system of joints and fractures but no preferred orientation of the veins could be measured due to the poor exposure.

Colour and Quality

The colour of the crystalline quartz within the deposit varies widely. In all cases, the veins and vughs are colour zoned from milky on the edge to clear to very pale purple to progressively darker purple towards the centre (Figs. 4 and 6).

Fig. 5 - Fullerville Amethyst Deposit
Quartz vein in quartzite showing well formed clear quartz crystalls in centre of vein. (Scale in millimetres).

Fig. 6 - Fullerville Amethyst Deposit
Typical Quartz vein material showing poorly formed interpenetrating crystals. Colour varies from milky to clear to purple to almost black.

In some cases the central part of the vein is dark brown or black in colour.

The colour of amethyst is believed to be produced by incorporation of ferric iron within the crystal lattice during crystallisation (Frondel, 1962).

The Fullerville amethyst has not been analysed to determine if there are higher levels of ferric iron within the coloured quartz compared to the milky quartz. Petrographic examination has shown that the purple coloured quartz contains more abundant finely divided inclusions. These are thought to be either fluid inclusions or finely divided opaque material and are at least partially responsible for the colour.

The Fullerville amethyst shows colour variation similar to that in morion from the Kathleen Patricia Morion Mine on Eyre Peninsula (Scott, 1977). This, together with the fact that smoky and black quartz (morion) is common at Fullerville suggests that the colour is secondary, produced by natural irradiation of initially colourless quartz. Like the Eyre Peninsula morion, Fullerville amethyst probably fades upon exposure as little if any dark amethyst was found on the dumps.

The crystal form of the Fullerville amethyst is also similar to the Eyre Peninsula morion. The quartz within the veins is an intergrown mass of crystals and well developed crystal faces are only present in the centre of the vughs or veins (Fig. 5). Prism faces are absent and terminations generally poorly developed.

The complexly intergrown nature of the crystals, the marked variation in colour, and the cloudy and fractured nature of much of the quartz makes most of the amethyst suitable only for specimens. Very small amounts of well crystallised amethyst may be suitable for cutting as a semi-precious stone.

Origin

The amethyst is believed to have formed by low to moderate temperature hydrothermal infilling of fractures and cavities in quartzite, similar to quartz veins throughout South Australia, particularly Miltalie Morion, and amethyst from the Hundred of Kelly, also on Eyre Peninsula (Nichol, 1975). Both the quartz and the small amounts of included iron oxide have been derived from the adjacent quartzite host. The well developed crystal terminations suggests that the fractures were open at the time of crystal growth and growth zoning indicates several stages of formation.

Reserves

Owing to the irregular nature of the quartz veins, reserves have not been estimated. Only a very small proportion of the amethyst (probably less than 2%) could be classed as a semi-precious stone. A much greater amount, possibly 30% has some value as specimen material. The use of poorer quality amethyst as an exposed aggregate in facing panels could be investigated.

CONCLUSIONS

Crystalline quartz veins carrying some amethystine quartz have developed in Belair Sub-Group quartzites near Fullerville in the Mid-North of South Australia. The marked colour variation within the quartz, the complexly intergrown nature of the crystals

and their cloudy and fractured habit renders most of the amethyst suitable for specimens only.

26-3-79

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APPENDIX A

Petrographic Description of samples
from Fullerville Amethyst Deposit.
Extracted from Amdel Report GS 4417/78
by Frank Radke.

Sample: P810/78; TS40420

Location:
Fullerville Amethyst Deposit

Rock Name:
Sandstone with vuggy quartz vein

Hand Specimen:
This rock consists of a massive, pale grey, slightly friable sandstone which contains a quartz vein varying in width between approximately 1 and 3 cm. The vein consists of cockscomb quartz crystals which, in one location, form a vug into which prismatic quartz crystals penetrate.

Thin Section:
An optical estimate of the constituents in the sandstone gives the following:

	%
Quartz	75
Sericitic matrix	20
Feldspar	3
Tourmaline	Trace-1
Zircon	Trace
Opaques	2

The thin section was cut to include both the quartz vein and the sandstone, and since the quartz vein is comprised completely of quartz, the above mineral proportions apply only to the sandstone, but approximately half of the thin section is comprised of the quartz vein.

The sandstone consists of detrital quartz particles set in an intergranular, sericitic matrix. The detrital quartz grains have a somewhat bimodal character, with most being about 0.15 mm in size, although some larger quartz grains generally between 0.4 and 0.8 mm in size are also present. The larger quartz exhibit subangular to subrounded shapes while the smaller quartz grins generally exhibit angular to subangular shapes. Minor detrital feldspar is also present and includes both polysynthetically twinned plagioclase and untwinned orthoclase.

The interstitial matrix consists mainly of finely-divided sericite flakes which have an interlocking, felted character. The matrix completely surrounds most quartz grains and locally forms interstitial patches up to 0.2 mm in size.

Detrital heavy minerals consist mainly of opaques with smaller amounts of tourmaline and a trace of zircon. The heavy tend to be concentrated in bands generally below 1 mm wide which are not well-developed. The detrital opaque grains have subangular to subrounded shapes and are generally below 0.15 mm in size. The tourmaline includes both pleochroic, green and pleochroic, yellowish-brown varieties and forms subangular to subrounded grains up to 0.25 mm in size. The detrital zircon tends to form relatively small, prismatic crystals below 0.1 mm in size.

The quartz vein consists almost exclusively of quartz, but locally does contain some interstitial opaque to translucent iron oxides located between the quartz crystals. The quartz vein is comprised of slightly smaller quartz crystals (generally below 0.5 mm long) near its contact with the sandstone, but further into the vein large crystals up to several millimetres in length penetrate into the vein.

This is a relatively fine-grained, detrital sediment with a well-developed quartz vein.

Sample: P811/78; TS40421

Location:
Fullerville Amethyst Deposit

Rock Name:
Quartz vug in sandstone

Hand Specimen:
Most of this sample is comprised of a quartz vug which exhibits a well-developed, cockscomb texture and is developed in a fine-grained, pale grey sandstone with a friable texture. The quartz crystals within the vug are up to about 1 cm wide and exhibit well-developed terminations where they penetrate into the vug. Most of the quartz crystals have a clear, pale grey colour, but many have a narrow (below 1 mm wide) outer rim with an opaque, white colour. Many of the quartz crystals which penetrate into the vug also have a slightly 'smoky' character near their terminations.

Thin Section:
The thin section was cut to include mainly the quartz vug, but one corner of the thin section includes the sandstone host. This sandstone host is like the host of the previously described rock (sample P810/78; TS40420), consisting of detrital quartz grains generally about 0.2 to 0.4 mm in size with a small proportion of interstitial, argillaceous matrix. The quartz generally exhibit somewhat recrystallised, sub-angular shapes. The argillaceous matrix is comprised mainly of finely divided sericite.

The quartz-filled vug consists of large crystals up to several millimetres in size which form a mosaic. Although most of the quartz crystals have somewhat anhedral shapes, several exhibit euhedral, prismatic shapes. In some cases the grain boundaries between the quartz crystals contain concentrations of smaller quartz crystals generally about 0.5 mm in size.

Traces of sericitic were noted locally as small, fibrous flakes below 0.1 mm in length included within the vein quartz. Finely divided micron-sized inclusions (probably fluid inclusions) are also locally concentrated within the vein quartz. These inclusions are locally concentrated in narrow bands or irregular patches, at least some of which could represent healed fractures. A few crystals also exhibit a concentration of these inclusions around their outer margins, where the quartz also exhibits a somewhat radial texture. These margins would represent the dull white rims noted on some crystals in hand specimen. Where these outer margins are in contact with the inner core of the crystal there is a concentration of finely divided sericite flakes in a band approximately 0.1 mm wide.

This rock is similar to sample P810/78 (TS40420).

Sample: P812/78; TS40422

Location:
Fullerville Amethyst Deposit

Rock Name:
Quartz vug in sandstone

Hand Specimen:
This sample is comprised of a weakly-friable, pale grey sandstone which contains a quartz vein or vug. The vug has a somewhat concentrically zoned character with its outer margin comprised of grey quartz and its inner protion comprised of larger, clear to mily white quartz crystals. The tips of the larger, inner quartz crystals have a purple, amethyst colour.

This Section:
The thin section was cut only from the quartz vug and is comprised almost exlusively of this quartz. The only contaminations are traces of finely divided phyllosilicates which tend to occur interstitially between the quartz crystals. The quartz crystals themselves have somewhat elongate, irregular-appearing shapes with a typical length of 1-5 mm. Most of the quartz has a very clear colour but a small proportion contains finely divided inclusions (probably) fluid inclusions) which are generally concentrated near the margins of some crystals. The quartz crystals within this rock form a somewhat irregular aggregate and at least locally exhibit fine, radial textures.

Sample: P813/78; TS40423

Location:
Fullerville Amethyst Deposit

Rock Name:
Quartz

Hand Specimen:
This sample is comprised of several quartz crystals which generally exhibit a zoned coloration ranging from a dull white to pale grey, to a purple amethyst. In many cases the same crystal appears to show such variations in colour.

Thin Sections:
Two thin sections were made of this sample, one each from a different crystal or crystalline aggregate.

One of the thin sections is comprised almost exclusively of a single quartz crystal, which has an amethyst zone. Petrographically, there is little difference between the amethystine region and the rest of the quartz crystal, except that the amethyst-coloured region contains more abundant, finely divided inclusions which are also generally slightly larger. Most of these inclusions are believed to be fluid inclusions, although some could represent finely divided opaque material. Their very fine size makes positive identification difficult in normal thin section. Some of these inclusions exhibit a crystallographic orientation along bands, but others appear to be concentrated along irregular fractures. The clear portion of the rock also contains similar inclusions, but they are generally not present at the same abundance.

The other thin section consists of a polycrystalline quartz aggregate which at least locally appears to have a somewhat deformed character. Only a small proportion of amethystine quartz was included within this thin section, and at least some of this quartz also exhibits a concentration of finely divided inclusions, although areas of clear quartz exhibit similar concentrations.

To conclude, it appears that the amethystine quartz generally has more abundant, finely divided inclusions which most likely represent fluid inclusions and possibly some finely divided opaque material, although even the white and clear quartz at least locally contains similar concentrations of such inclusions.